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SIMPLEX TRIANGULATION INDUCED SCALE-FREE NETWORKS

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Abstract. We propose a simple rule that generates scale-free networks with very large clustering coefficients and very small average distances. These networks are called simplex triangulation networks (STNs) as they can be considered as a kind of network representations of simplex triangulations. We obtain the analytic results of the power-law exponent $\gamma = 2 + \frac{1}{d-1}$ for d-dimensional STNs, and the clustering coefficient C. We prove that the increasing tendency of the average distances of STNs is a little slower than the logarithm of the number of their nodes. In addition, the STNs possess hierarchical structures as $C(k) \sim k^{-1}$ when $k \gg d$, which is in accordance with the observations of many real-life networks.

Keywords. complex network, simplex triangulation, scale-free network, small-world network, clustering coefficient, average distance

AMS (MOS) subject classification: 05C75, 05C80

1 Introduction

Recently, empirical studies indicate that networks in various fields have some common characteristics, which inspires scientists to construct a general model [1-3]. The most important characteristics are the scale-free property and the small-world effect. The former means that the degree distribution obeys a power law as $p(k) \propto k^{-\gamma}$, where k is the degree, $p(k)$ is the probability density function for the degree distribution, and γ is called the power-law exponent, which is usually between 2 and 3 in real-life networks. The latter involves two factors: small average distance as $L \sim \mathtt{ln}N$ and great clustering coefficient C, where L is the average distance, N is the number of nodes in the network, and C is the probability that a randomly selected node's two randomly picked neighbors are neighbors. One of the most well-known

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